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WEED FLORA OF DIFFERENT FARM BLOCKS IN BLOCK-1 OF MUDA RICE GRANARY IN PENINSULAR MALAYSIA

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Abstrak: Satu peninjauan terhadap flora rumpai di Blok-1, kawasan padi Muda, Semenanjung Malaysia, menunjukkan terdapat 28 spesies rumpai tergolong dalam 15 famili di kawasan ini. Tiga belas spesies adalah rumpai daun lebar, enam daun tirus, enam rusiga, dan tiga akuatik. Indeks Kesamaan Sorenson (S) menunjukkan sekurang-kurangnya 24.2% spesies berlaku di kesemua lima blok. *Oryza sativa* kompleks (padi angin) dan *Echinochloa crus-galli* didapati dominan di semua blok, tetapi paling banyak di blok AI, BI dan DI dengan mempunyai nisbah serangan yang serius (skor 3 ke 5: 31%–50% litupan rumpai). *Leptochloa chinensis* adalah yang paling dominan di blok AI dan EI dengan mempunyai skor keterukan 3, iaitu masing-masing 30% dan 20% litupan rumpai di blok BI dan CI. Spesies-spesis lain seperti *Ischaemum rugosum*, *Fimbristylis miliacea*, *Scirpus grossus*, *Sphenoclea zeylanica* dan *Cyperus difformis* mempunyai tahap skor sehingga 20% (skor 2) litupan rumpai. Hierarki jenis rumpai mengikut nisbah peratus serangan keseluruhan blok adalah: daun tirus (G) > daun lebar (BL) > rusiga (SG) > akuatik (AQ) dengan sedikit berbeza pada blok AI, di mana rusiga adalah lebih dominan daripada rumpai daun lebar, rumpai akuatik tidak didapati dan rumpai daun tirus adalah pradominan berbanding dengan blok lain.

Katakunci: Flora rumpai, Blok Tanaman, Kawasan padi Muda, Malaysia

Abstract: A survey on the major weed flora of rice fields in Block-1 of Muda rice granary area, Peninsular Malaysia, indicated there were 28 weed species belonging to 15 families in this area. Of these, 13 species were broad-leaves, six grasses, six sedges, and three aquatics. Sorenson's Index of Similarity (S) indicated that at least 24.2% of the listed species occurred in five blocks. *Oryza sativa* complex *(padi angin)* and *Echinochloa crus-galli* appeared wide spread species in all blocks, but were most abundant in block AI, BI and DI having a greater proportion of severe infestations (scores of 3 to 5: 31%–50% weed cover). *Leptochloa chinensis* was the most frequent and abundant species in block AI and EI having the severity score of 3, i.e. 30% and 20% (score of 2) weed coverage in block BI and CI, respectively. Other weed species such as *Ischaemum rugosum*, *Fimbristylis miliacea*, *Scirpus grossus*, *Sphenoclea zeylanica* and *Cyperus difformis* were having 20% (score of 2) weed coverage. The hierarchy of weed type based on the percentage of field infested ratio was in the order of: grasses (G) > broad-leaved weeds (BL) > sedges (SG) > aquatics (AQ) in all blocks with a slight difference in block AI, where sedges were dominant instead of broad-leaved weeds, aquatic weeds were totally absent and grasses were predominant as compared to other blocks.

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Keywords: Weed Flora, Farm Blocks, Muda Rice Granary, Malaysia

INTRODUCTION

In Peninsular Malaysia, rice is mainly grown in eight granary areas covering an area of about 209 300 ha. Among these, the largest granary is Muda in Kedah which covers 98 860 ha with a rice production of 4.12 t/ha (Abd. Kadir & Kamariah 2003). Weeds represent a major constraint in yield losses depending on season of crop sowing, weed species, weed density, rice cultivars, growth rate and density of weed and rice (Ho 1984). Azmi (1988) estimated that the yield loss due to grasses mainly *Echinochloa crus-galli*, broad-leaved weeds and sedges were 41%, 28% and 10%, respectively.

The composition of the weed flora may differ depending on location (Janiya & Moody 1983), water supply (Bhan 1983), cultural practices (Bernasor & De Datta 1983; Mabbayad *et al.* 1983) the inherent weed flora in the area, and the crop grown. Moody and Drost (1983) reported that the weed flora in any rice field was usually about ten species, of which the dominant ones were rarely more than three to four species. In Muda area, there was a distinct switch towards the practice of direct seeding rice culture since 1980. This practice was more conducive to weed growth especially the more competitive grassy weeds (Moody & De Datta 1982; Ho & Zuki 1988). In addition, the ecological shift of weed species from broad-leaved weeds and sedges in transplanted rice culture to competitive grassy weeds in direct seeded rice, was found to be related to the continuous use of herbicides in weed control operation (Azmi & Baki 1995; Ho 1998). The build up of certain weed species after continuous use of a particular herbicide might be due to the inherent resistance to that herbicide or gradual development of herbicide resistance (Azmi 2002). Sometimes, elimination of the competitors of a particular weed favors the abundance and predominance of that particular weed. Molinate suppressed *Echinochloa crus-galli*, but resulted in escalated infestation of *Leptochloa chinensis* and *Ischaemum rugosum* (Ho & Itoh 1991). Prolonged usage of graminicides reduced the infestation of other grassy weeds but created the dominancy of weedy rice in Sekinchan Farm Block, Selangor's South West Project (Azmi & Baki 2003). It was reported that the changes in cultural practices and uses of agrochemicals led to the shifting of weed species in different rice granaries in Malaysia (Azmi & Anwar 1988; Azmi *et al.* 1993; Azmi & Mashhor 1995; Pane 1997). Generally in any field, the weed flora was, in part, a result of the agronomic management decisions, i.e. time and type of tillage, crop establishment technique, irrigation and fertilizer used, and type, rate and effectiveness of herbicide used, etc. carried out by the farmer. Monitoring these changes in a specific location is important to formulate appropriate weed management strategies.

Data on the presence composition, abundance, importance and ranks of weed species that infest the rice grown according to farmers' blocks under Block-1 in Muda area is completely lacking. Understanding the nature and extent of

infestation of weed flora through weed survey in a particular field situation is much effective for weed control measures rather than accepting a countrywide blanket recommendation for a single herbicide and dose. The more knowledge we have of the dominant weed species in our rice fields, the closer we will come to their efficient control. Knowledge of the residual species and their distribution in this area would help in formulating relevant weed control strategies. Therefore, the present study was undertaken to investigate the distribution and severity of weed flora prevailing in different blocks at Block-1 in Muda area.

MATERIALS AND METHODS

A survey was conducted at the heading stage of direct seeded rice crop at Muda in Kedah from 5th to 20th July 2003. Rice fields surveyed covered Block-1 of five farm blocks with 97 fields. Before starting the survey, a route was planned to provide adequate coverage of the whole area. All fields adjacent to the route were assessed irrespective of size. Visual assessments were made on the occurrence and density of individual weed species by two persons walking along one side and again when returning along the opposite side of the field. The percentage cover of weeds prevailing above the rice canopy was based on the whole field, whereas the percentage cover of weeds below the crop canopy was taken from four randomly selected 1 m^2 quadrats, placed on each side of the rice field. This method was adapted both to reduce the time taken to survey a field and to prevent possible damage to the crop (Chancellor & Froud-Williams 1982, 1984; Elazegul *et al*. 1990).

The percentage weed cover prevailing above and below the rice canopy was assessed on a whole field basis. Care was taken in the identification of weed species. As most grasses were in the flowering stage, assessments could be made quite readily. Where several grasses occurred together, particular care was also taken in assessing their relative proportions. Any plant that could not be identified was tagged, pressed and submitted for positive identification.

All weed species present were recorded and scored for distribution and frequency. A rating scale of 1 to 10 was used to denote weed cover (Pablico & Moody 1985), where Tr = a few scattered plant, the lowest score of 1 = 1%–10% weed cover, while the maximum score of 10 = 91%–100% weed cover.

Comparison of species affiliation among weed communities between districts were made using the “Sorenson’s Index of Similarity” (Goldsmith *et al*. 1986). Computation of the S values is as follows:

$$S = \frac{2J}{A + B} \times 100$$

where, S = Comparison of species association between block A and B

J = Number of species common to both A and B
A = Number of species present at block A
B = Number of species present at block B

Higher S value indicates close similarity in species composition between blocks. Conversely, lower S values reflect divergence in species composition in the two blocks.

RESULTS AND DISCUSSION

Distribution of Weeds within the Blocks

Of the 97 fields assessed, a total of 28 weed species belonging to 15 families were recorded, ranging from as few as 10 in block AI to a maximum of 23 in block DI. The distribution of weed species varied within the blocks. Hierarchical order of species composition's ranking were as follows: Block DI (23) > Block EI (21) > Block BI (20) > Block CI (13) > Block AI (10) (Table 1). Gramineae and Cyperaceae families with six weed species made up the highest number of weed species followed by Scrophulariaceae and Onagraceae which consisted of three and two species, respectively. The other family consisted of only one weed species. In general, broad-leaved weeds were the highest in number including two ferns, namely *Marsilea crenata* Presl and *Ceratopteris thalictroides* (L.) Brongn; while grasses were the most wide-spread species (Table 2).

Table 1: The number of fields surveyed and the number of weed species observed in different blocks under four blocks of Muda area

Region	Block name	No. of fields	No. of species recorded	No. of family
Block-1	AI	19	10	4
	BI	18	20	13
	CI	10	13	9
	DI	20	23	14
	EI	30	21	12

Table 2: Distribution of weed species in different farm blocks of Muda area

Weed species	Family	% weed infestation in different blocks				
		AI	BI	CI	DI	EI
Oryza sativa	Gramineae	100.0	100.0	100	100	100.0
Echinochloa crus-galli	Gramineae	100.0	83.3	90	100	93.3
Leptochloa chinensis	Gramineae	89.5	77.8	80	90	86.7
Ludwigia hyssopifolia	Onagraceae	68.4	38.9	40	95	50.0
Fimbristylis miliacea	Cyperaceae	84.2	33.3	10	65	36.7

(continue on next page)

Table 2: *(continued)*

Weed species	Family	% weed infestation in different blocks				
		AI	BI	CI	DI	EI
Ischaemum rugosum	Gramineae	68.4	-	-	20	10.0
Scirpus grossus	Cyperaceae	26.3	55.6	60	30	6.7
Cyperus iria	Cyperaceae	42.1	27.8	10	10	16.7
Sphenoclea zeylanica	Spenocleacea	-	38.9	80	25	60.0
Echinochloa colona	Gramineae	-	-	-	5	10.0
Bacopa rotundifolia	Scrophulariaceae	-	5.6	-	5	6.7
Cyperus babakensis	Cyperaceae	5.3	-	-	-	-
Limnocharis flava	Butomaceae	15.8	16.7	40	-	3.3
Utricularia aurea	Lentibulariaceae	-	22.2	30	20	3.3
Monochoria vaginalis	Pontederiaceae	-	5.6	-	15	-
Sagittaria guyanensis	Alismataceae	-	11.1	-	5	-
Cyperus difformis	Cyperaceae	-	-	-	5	50
Marsilea crenata	Marsileaceae	-	27.8	-	25	3.3
Najas graminea	Najadaceae	-	20.0	-	10	20.0
Limnophila erecta	Scrophulariaceae	-	11.1	-	-	6.7
Lemna perpusilla	Lemnaceae	-	22.2	10	10	3.3
Ceratopteris pteridoides	Parkeriaceae	-	-	20	15	6.7
Hedyotis corymbosa	Rubiaceae	-	-	-	10	-
Ludwigia ascendens	Onagraceae	-	16.7	-	15	-
Paspalum vaginatum	Gramineae	-	-	-	5	-
Nymphoides indica	Gentiaceae	-	16.7	10	5	3.3
Lindernia pusilla	Scrophulariaceae	-	5.6	-	-	-
Eleocharis variegata	Cyperaceae	-	-	-	-	3.3

The difference in the number of species found between the blocks was likely due to the occurrence of minor species. The most frequent species occurring five species present (according to > 30% field infested value) in each block were *Oryza sativa* complex, *Echinochloa crus-galli*, *Leptochloa chinensis*, *Ludwigia hyssopifolia*, *Fimbristylis miliacea* except *F. miliacea* with 10% infestation in block CI (Table 2). *Oryza sativa* complex was distributed uniformly among all farm blocks with 100% of the field infested. Farm blocks AI and DI were 100% infested with *Echinochloa crus-galli*, while farm blocks were infested 83.3%, 90% and 93.3% with this species respectively. The coverage of farm blocks AI, BI, CI, DI and EI with *Leptochloa chinensis* were 89.5%, 77.8%, 80%, 90% and 86.7%, respectively. The relative occurrence of *Ludwigia hyssopifolia* among the five blocks were ranged from 39%–95% and the occurrence of *Fimbristylis miliacea* ranged from 33.3% to 84.2% for block AI, BI, DI and EI. In addition, other widespread species such as *Ischaemum rugosum* (68.4%) and *Cyperus iria* (42.1%) were found in block AI, and *Sphenoclea zeylanica* found in block BI, CI and EI with 38.9%, 80% and 60% coverage respectively. *Scirpus grossus* could also be found in block BI (55.6%) and CI (60%). Moreover, 40% of block CI was infested with *Limnocharis flava* and *Utricularia aurea*. *Cyperus difformis* covered 50% of block EI. The remaining species occurred in less than 30% of the fields and were of no great importance (Table 2). Kim *et al.* (1983) reported that in a given environment, the weed vegetation was most strongly affected by the biotic factors, particularly cultivation practices such as irrigation, usage of fertilizer, cultivars grown, tillage, herbicide usage and crop rotation.

Based on Sorenson's Index of Similarity, the low value of this index (24.2–40.9) indicated the dissimilar occurrence of weed species among the blocks (Table 3). The dissimilarity existed due to the presence of a higher number of less frequent and abundant species. Among the blocks, the highest similarity index (40.9) was observed between block DI and EI and the lowest (24.2) between block AI and DI, this indicated that the difference of number of occurring weeds species between these blocks was lower and higher, respectively.

Table 3: Sorenson's index of similarity of weed species among the five Blocks of Block-1 in Muda rice granary areas

Blocks	Block AI	Block BI	Block CI	Block DI	Block EI
AI	–	26.7	34.8	24.2	29.0
BI	26.7	–	36.4	39.5	39.0
CI	34.8	36.4	–	33.3	38.2
DI	24.2	39.5	33.3	–	40.9
EI	29.0	39.0	38.2	40.9	–

Grasses were the dominant species followed by broad-leaved weeds, sedges and aquatic weeds in all the blocks except block AI, where grasses were the dominant species followed by sedges than the broad-leaved weeds while the aquatic weeds were totally absent (Fig. 1). The difference in distribution of different weed groups between these blocks could reflect the differences in agronomic practices, especially water management. In block AI, it might be due to low water availability of that increased sedges and grasses infestation and suppressed broad-leaved and aquatic weeds. Azmi *et al*. (1993) observed that the hierarchical importance of weed type (grasses, broad-leaved weeds, sedges and aquatics) varied considerably between and within each rice granary was due to differences in microclimatic and agronomic practices prevailing in those areas.

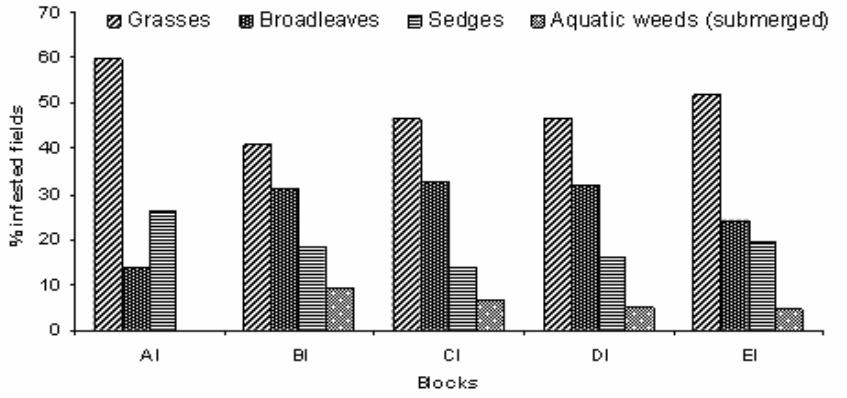

Figure 1: Weed group profile in five farm blocks under Block-1 of Muda rice granary area

Severity of Weed Infestation

Oryza sativa complex and *Echinochloa crus-galli* appeared to be the wide-spread species in all blocks. They were most abundant in block AI, BI and DI with a greater proportion of severe infestations (scores of 3 to 5: 31%–50% weed cover). *Leptochloa chinensis* was the most frequent and abundant species in blocks AI and EI having the severity score of 3, i.e. 30% weed coverage, and in blocks BI and CI the rating score for weed coverage was 20%. Other frequent species having the rating score of 2 (20% weed coverage) were *Ischaemum rugosum* (block AI), *Fimbristylis miliacea* (blocks AI, EI), *Scirpus grossus* (blocks BI, CI) *and Sphenoclea zeylanica* (blocks CI, EI). *Ludwigia hyssopifolia*, *Cyperus iria*, *Cyperus difformis*, *Limnocharis flava* and *Utricularia aurea* were frequently found but only appeared trace to 10% weed coverage (Table 4). The variation of dominant species among the blocks could be due to the biotic and abiotic factors, particularly cultural practices such as irrigation, fertilizer, cultivars grown, tillage, herbicide usage and crop rotation as reported by Kim *et al.* (1983).

Table 4: Severity of infestation of weed species in different farm blocks of Block-1 in Muda rice granary area

Weed species	Weed infestation (% cover)[a]						Total no. of infested fields
	Tr	1	2	3	4	5	
Block AI (Total fields 19)							
Oryza sativa	1	4	6	7	1	-	19
Echinochloa crus-galli	5	4	9	1	-	-	19
Leptochloa chinensis	5	6	5	1	-	-	17
Fimbristylis miliacea	11	3	2	-	-	-	16
Ludwigia hyssopifolia	10	3	-	-	-	-	13
Ischaemum rugosum	5	7	1	-	-	-	13
Cyperus iria	4	4	-	-	-	-	8
Block BI (Total fields 18)							
Oryza sativa	9	5	2	2	-	-	18
Echinochloa crus-galli	7	1	3	2	1	1	15
Leptochloa chinensis	7	6	1	-	-	-	14
Scirpus grossus	6	-	4	-	-	-	10
Ludwigia hyssopifolia	7	-	-	-	-	-	7
Sphenoclea zeylanica	3	4	-	-	-	-	7
Fimbristylis miliacea	5	1	-	-	-	-	6
Block CI (Total fields 10)							
Oryza sativa	7	3	-	-	-	-	10
Echinochloa crus-galli	8	1	-	-	-	-	9
Leptochloa chinensis	2	4	2	-	-	-	8
Sphenoclea zeylanica	-	7	1	-	-	-	8
Scirpus grossus	4	1	1	-	-	-	6
Ludwigia hyssopifolia	4	-	-	-	-	-	4
Limnocharis flava	4	-	-	-	-	-	4
Block DI (Total fields 20)							
Oryza sativa	2	7	4	2	2	3	20
Echinochloa crus-galli	4	8	5	3	-	-	20
Ludwigia hyssopifolia	14	5	-	-	-	-	19
Leptochloa chinensis	15	3	-	-	-	-	18
Fimbristylis miliacea	13	-	-	-	-	-	13
Block EI (Total fields 30)							
Oryza sativa	9	17	4	-	-	-	30
Echinochloa crus-galli	21	6	1	-	-	-	28
Leptochloa chinensis	15	6	3	2	-	-	26
Sphenoclea zeylanica	11	6	1	-	-	-	18
Cyperus difformis	9	1	5	-	-	-	15
Ludwigia hyssopifolia	15	-	-	-	-	-	15
Fimbristylis miliacea	7	1	3	-	-	-	11

[a]Rating scale: Tr = a few scattered plant, 1 = 1%–10% weed cover; 2 = 11%–20% weed cover; 3 = 21%–30% weed cover; 4 = 31%–40% weed cover; 5 = 41%–50% weed cover.

The present study showed that *Oryza sativa* complex was the most dominant grass species, infesting almost 100% of rice fields with high levels of occurrence. Vaughan *et al*. (2003) mentioned that the wide-spread occurrence of weedy rice in Malaysian rice culture was due to (i) the practices of direct seeding and volunteer seedling rice culture; (ii) the use of easy shattering varieties; and (iii) the use of combine harvesters, which moved from one rice growing area to

another. The apparent increase in the spread of *Oryza sativa* complex was of utmost concern. The other dominant and equally important weeds were *Echinochloa crus-galli* and *Leptochloa chinensis* (grasses weed), *Ludwigia hyssopifolia* (broad-leaved weed) and *Fimbristylis miliacea* (sedge). Begum *et al*. (2005) observed that *Oryza sativa* complex ranked top followed by *Leptochloa chinensis*, *Echinochloa crus-galli*, *Ludwigia hyssopifolia* and *Fimbristylis miliacea* in the Block-1.

CONCLUSION

The grassy weed species were the dominated species in Block-1 of Muda rice granary area with more than 50% fields infested and a rating score of 2 to 5 in 4 blocks except CI. The four dominant grassy species, *Oryza sativa* complex, *Echinochloa crus-galli*, *Leptochloa chinensis*, and *Ischaemum rugosum* could be found in different blocks of the districts. The most wide-spread and abundant infestation with grassy weeds was in block AI.

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